

SESSION 3

Maintenance of Dams and Spillways



Objectives for Session

- Importance of maintenance
- Examples of maintenance items and why it is important to repair these items
- Ways to address
- Examples of good maintenance



Why is maintenance important?



“Maintenance is needed to continue to realize local benefits and to keep the dams safe.”

▶ National Watershed Coalition, 2010



Regardless of the type of dam,
all dams must be properly
operated, maintained, and
inspected by owners



Good maintenance program

- ▶ Will protect against deterioration and will prolong life
- ▶ Will protect the owner and as well as the public
- ▶ Will have a small cost compared to costs of major repairs, loss of life and property, and litigation



Maintenance of dam



Vegetation









03/27/2013





Vegetation

- Why do I need to mow the grass on the dam? Why do I need to remove trees?
 - Tree roots can become pathways for seepage and can alter the structural integrity
 - Tall grass provides a haven for burrowing animals.
 - Tall grass and brush make inspections more difficult.
 - Trees can blow over in high winds and severely damage the embankment.



Vegetation Control

- All brush, vines, briars, and bamboo should be cut and removed from the dam.
- All trees with a diameter of 4-inches or less should be cut at ground level. The stumps should be treated with a waterproof sealant to prolong stump decay. A professional engineer should be contacted if the roots are to be removed.
- All trees with a diameter of 4-inches or more should be removed under the supervision of a professional engineer in order to preserve the integrity of the dam. The root systems should be removed and the cavity backfilled with compacted impervious fill.





















Cost for owner

- ▶ Work done by owner
- ▶ Length of time about 10 days for 4 or 5 employees
- ▶ Cost about \$5,000



Cracking







Cracking

- ▶ Desiccation cracks are usually associated with drying due to lack of rain
- ▶ Desiccation cracks can result in saturation of the dam when rains occur, which could result in slides
- ▶ Structural cracking is usually associated with movement of the dam
- ▶ Structural cracks could indicate a problem with the dam that needs the attention of an engineer



Cracking

- Desiccation cracks
 - Cover cracks with top soil and re-vegetate area.
- Longitudinal and transverse cracking
 - An engineer may need to be retained if significant cracking to determine the cause of the cracking and to make recommendations for correction



Rutting and Low Areas







01/29/2013



Rutting and Low Areas

- ▶ Ruts and low areas can collect rain water, which can cause saturation and softening of the dam
- ▶ Low areas could be sign of settlement or collapse of animal holes



Rutting

- Drain any standing water
- Regrade and re-compact fill
- Slope crest to upstream slope
- Periodically regrade



Low Areas

- Low areas on large and intermediate size dams
 - Install monuments to determine if settlement is occurring. Take readings on time frame recommended by engineer
 - Engineer should evaluate readings



Low Areas

- Low areas on small dams
 - Determine if low areas are the result of collapse of animal dens
 - Remove material from crest if from animal dens
 - Fill in low areas and re-compact
 - Re-vegetate areas



Animal Activity

















Animals, why be concerned?

- ▶ Burrowing animals can endanger the structural stability of the dam
- ▶ The burrows and tunnels weaken the embankment and serve as pathways for seepage
- ▶ Burrowing animals are creating more problems
- ▶ Hogs destroy the protective vegetative cover
- ▶ Livestock trails can promote severe erosion
- ▶ Livestock can overgraze the vegetative cover



Animal Control

- Take measures to eliminate the burrowing animals; i.e., beavers, nutria, badgers, weasels, or gophers and feral hogs
- Texas Wildlife Services Program
 - State office 210/472-5451
 - www.aphis.usda.gov/wildlife_damage



Repair of Animal Activity

- For burrows/dens, excavate, backfill, compact, and seed. Also, you can fill hole with grout, cover with soil, and seed or re-vegetate
- For livestock trails, fill with soil and compact and then re-vegetate
- For hog damage, re-vegetate the damaged area after repairs





Fire Ant Activity, what harm?

- ▶ Ants can reduce soil compaction
- ▶ Nests can penetrate as much as 4 feet into dams
- ▶ Pathways for seepage
- ▶ Mounds can create problems for mowing
- ▶ Ants can cause corrosion on electrical systems
- ▶ Ants can cause electrical systems to not work when needed





Fire Ants

- Use pesticides suitable for location
- Do not contaminate water
- Texas Imported Fire Ant Research and Management Project
- www.fireant.tamu.edu



Erosion













Erosion

- ▶ One of the most common maintenance problems at embankment structures
- ▶ Periodic and timely maintenance is essential to prevent continuous deterioration and possible failure
- ▶ The cause of the erosion will have a direct bearing on the type of repairs



Erosion Repair

- Wave Action erosion
 - Reestablish slope protection including bedding material. An engineer may be required to design the slope material
 - Extensive damage may require flattening the slope before replacement of the slope protection



Erosion Repairs

- Erosion gullies
 - Restore the slope by repairing the area with competent material and compacting material
 - Address the cause for the erosion
 - Cover the repaired area with topsoil
 - Re-vegetate the repaired area



Instability







Slides

- ▶ Can be attributed to infiltration of water into the embankment or loss of support by the foundation
- ▶ Structural collapse or overtopping can occur if slide is through the crest



Slide Repairs

- Engineer should evaluate cause of slide and recommend correction
- May require lowering the lake level
- May require slide area to be stabilized with lime



Seepage





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Seepage

- ▶ Continued flows can saturate parts of the dam and lead to slides, erosion, or failure
- ▶ Can result in sudden failure due to piping through the dam



Seepage

- Monitor seepage regularly to determine if flow is increasing or if soil material is being carried in the flow.
- If quantity of flow is increasing or the flow becomes muddy, an engineer should be retained to evaluate the condition and make recommendations for further action
- May require lowering the lake level



Seepage

- If a boil develops along the downstream toe, an engineer needs to be retained as soon as possible
- Repairs may include a dike of sand bags or earth around the boil to control the water flow before more extensive work can be done
- May require lowering the lake level



Toe Drain Systems







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Toe Drains

- ▶ Can result in water backing up into embankment, raising water pressures readings and possibly causing embankment slides or failure
- ▶ Requires regular maintenance and cleaning



Toe Drains

- Clear vegetation around the drain and well outlets
- Measure and monitor flow from outlets
- Keep outlet clear of algae, especially those with flap gates
- Have engineer evaluate data from drains and wells



Instrumentation



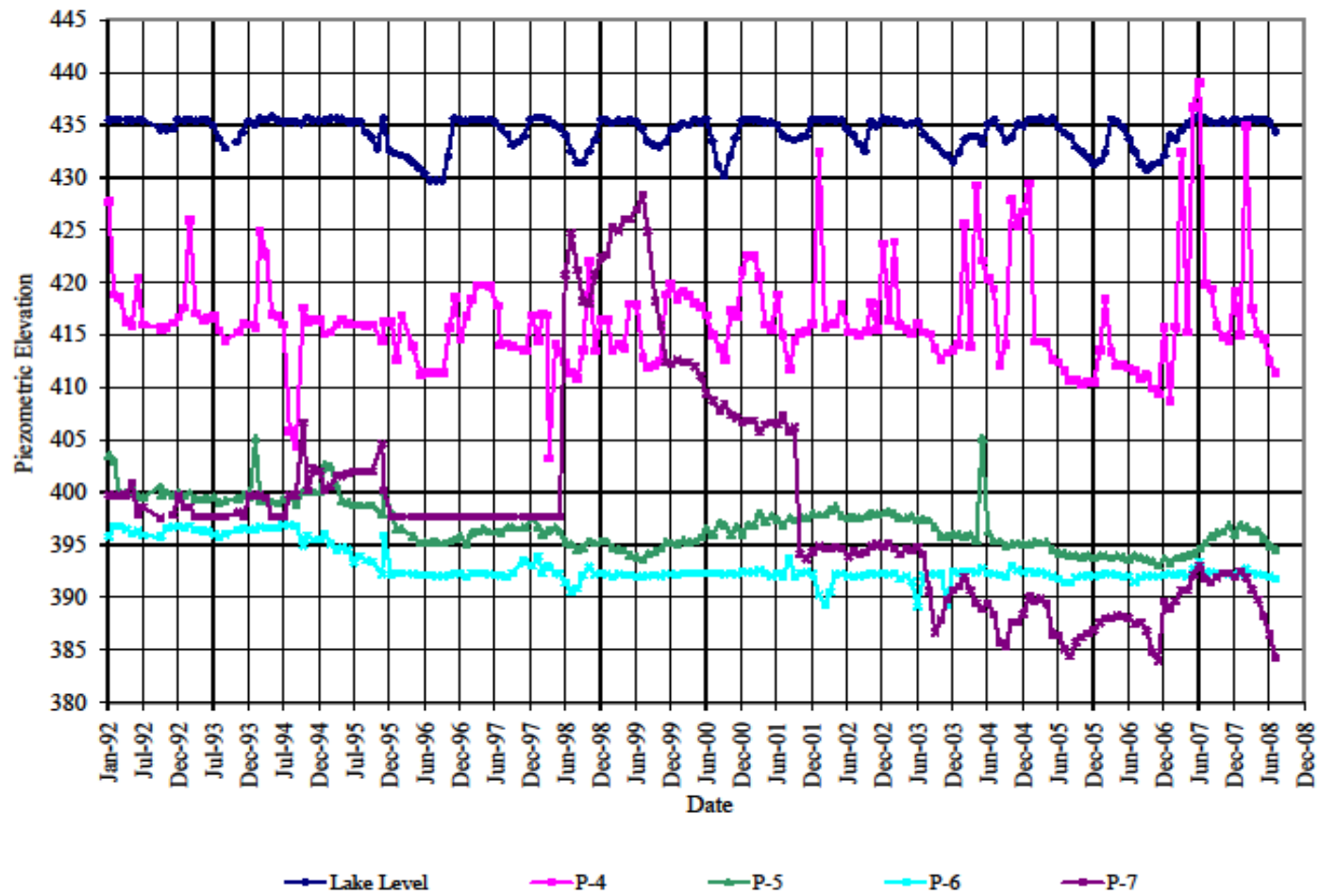




Instrumentation

- ▶ Have engineer evaluate instrumentation data to determine if the instrument is still working and if there is a problem
- ▶ Collect data on schedule provided by your engineer
- ▶ Protect instrumentation from damage during maintenance activities





Concrete







Concrete Structures

- ▶ Movement could be occurring, which could cause the wall to collapse or the floor to buckle
- ▶ Seepage could indicate that flow is causing a problem under the concrete



Concrete Structures

- Monitor seepage flow and cracking for increases in flow or size of crack
- Spalling generally requires an engineer's evaluation to determine cause and method to repair
- Readings need to be taken on measuring equipment until engineer determines that no additional readings are necessary.









Maintenance of Spillways







Vegetation

- ▶ Tree roots will damage the concrete and cause movement of walls and slabs
- ▶ Vegetation will block or hinder flow through channels and inlets, possibly raising lake levels and overtopping the dam



Vegetation

- Remove all trees and brush from earth-cut spillways
- Remove vegetation from around inlets. Remove trees and brush from around concrete structures and pipes. Care should be taken to avoid damage to the concrete during removal.



Debris and other blockage of spillway channels and inlets

- Remove beaver dams from entrances to spillways
- Remove debris from inlets and trashguards
- Remove fences from spillway channels. If one is required due to stocking with grass carp, the fence needs to be a distance away from the spillway crest to allow unobstructed flow





Erosion

- Repair erosion channels or gullies as soon as possible. Use good compacted fill and cover with rock riprap or a high performance turf reinforcement mat.
- Establish a good grass cover in repaired areas
- Erosion around inlets and along conduits will require an engineer to determine the problem and recommend a correction





Erosion beneath concrete or at outlets

- Undermining or undercutting of concrete or outlet structures can cause collapse of the structure and will require an engineer to determine the most appropriate method of repair
- May require construction of a cutoff wall, properly placed compacted fill, and some type of erosion protection such as rock riprap
- An undermined structure may have to be replaced







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Cracking and open joints

- Cracks should be monitored for movement. If movement is occurring, an engineer should be consulted
- For small cracks and narrow open joints, the cracks and joints should be cleaned and sealed with a flexible, water resistant sealant
- For large joint openings, an engineer should be consulted to determine the cause for the movement







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Seepage or drainage systems

- Monitor any flow from under a concrete spillway and any flow from any drainage system
- If flow increases or there is soil material in the flow, contact your engineer for recommendations for correction
- If the flow increases rapidly or the amount of soil increase, the reservoir may need to be lowered under the direction of your engineer and make notification under your emergency action plan







Joint separation of outlet pipes

- Will require an engineer to determine the method for repair
- May require replacement of the pipe or slip-lining the pipe with a smaller pipe and grouting between the two pipes



Pipe deterioration

- Pipe deterioration is usually associated with a corrugated metal pipe (CMP)
- Deterioration usually requires replacement of the pipe or slip-lining the pipe with a smaller pipe and grouting between the pipes
- If the pipe is replaced, do not replace with another CMP. CMPs should not be used in dams
- This will require an engineer and should be undertaken as soon as possible to avoid erosion of the dam









12/03/2008





Good Maintenance

















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- *Guidelines for Operation and Maintenance of Dams in Texas*
- *Dam Removal Guidelines*



Web Site

- ▶ The web site for the rules and the guidelines is:
- ▶ http://www.tceq.texas.gov/compliance/field_ops/dam_safety/damsafetyprog.html



Dam Safety Section

TCEQ

MC-177

P. O. Box 13087

Austin, Texas 78711

warren.samuelson@tceq.texas.gov

(512/239-5195)

megan.dutton@tceq.texas.gov

(512/239-0459)



Questions

